REMARKS

Claims 1, 38, and 79-82 are amended hereby. No claims are canceled or newly added. Accordingly, after entry of this Amendment, claims 1-6, 8-20, 22, 24-26, 28-41, 43-55, 57, 59-61, and 63-82 remain pending.

In the Final Office Action dated March 20, 2007, the Examiner withdrew the objection of the drawings and withdrew the 35 U.S.C. § 112 2nd paragraph rejection of claims 37 and 74.

In the Final Office Action, the Examiner rejected claims 1-6, 8-15, 17-20, 22, 24-26, 28-41, 43-50, 52-55, 57, 59-61, 63-74, and 75-82 under 35 U.S.C. § 103(a) as being unpatentable over Chung et al. (U.S. Patent Publication 2003/0203616) in view of Lai et al. (U.S. Patent 6,939,804). In addition, claims 16 and 51 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chung et al. and Lai et al. in view of Elers et al. (U.S. Patent Publication 2003/0203616). The Applicant respectfully disagrees with each of these rejections and, therefore, respectfully traverses the same.

In response, the Applicant has amended independent claims 1 and 38, and claims 79-82 depending from independent claim 38 to clarify the invention and to overcome the references cited in the Final Office Action. The Applicant respectfully submits that all of claims 1-6, 8-20, 22, 24-26, 28-41, 43-55, 57, 59-61, and 63-82 are patentable over the references cited by the Examiner because they recite a method of depositing a metal layer on a substrate (claim 1) or a method of depositing a W layer on a substrate (claim 38) that combines a number of features including, among them, performing a plurality of deposition cycles to deposit a metal layer (claim 1) or a W layer (claim 38) with a desired total thickness, each deposition cycle comprising: first, exposing the substrate to a metal-carbonyl precursor gas (claim 1) or a $W(CO)_6$ precursor gas (claim 38) to deposit a thickness greater than 5 angstrom of the metal layer (claim 1) or the W layer (claim 38) on the substrate, wherein the substrate is maintained at a substrate temperature that results in thermal decomposition of the metal-carbonyl precursor gas (claim 1) or the $W(CO)_6$ precursor gas (claim 38), and second, exposing the metal layer (claim 1) or the W layer (claim 38) to a reducing gas.

None of the references describe or suggest at least this combination of features. Therefore, the Applicant respectfully submits that all of claims 1-6, 8-20, 22, 24-26, 28-41, 43-55, 57, 59-61, and 63-82 are patentable thereover.

Regarding claim 1, the Examiners refers to paragraphs [0030] – [0034] and [0046] in Chung et al. to conclude that a method is disclosed of depositing a metal layer on a substrate by providing a substrate to a process chamber and performing a deposition cycle until the thickness of the metal layer is greater than 5 A by exposing the substrate to a metal-carbonyl and reducing gas. A careful review of these paragraphs in Chung et al. shows that a plurality of deposition cycles are performed to achieve a thickness greater than 5 A. In particular, 30 deposition cycles are performed to deposit a thickness of about 30 A. Therefore, a thickness of about 1 A is deposited in each deposition cycle, not a thickness greater than 5A in each deposition cycle as required by claim 1.

The Examiner refers to Column 2, lines 1-20 to conclude that Lai et al. uses a similar process as Chung et al. but also teaches that a precursor may be thermally decomposed in a CVD process, and that this would imply that the substrate is at a temperature to achieve this. The Examiner further refers to Figure 8A of Lai et al. which shows that the film thickness is a function of precursor exposure time, and the Examiner states that precursor exposure in Lai et al. (Column 6, lines 37-55) is modified depending upon the equipment used and thickness desired. The Applicant respectfully points out that FIG. 8A shows deposition rates for a tungsten nucleation layer formed using a cyclical deposition process, where the deposition rate saturates at about 1.1A/cycle (110A/100cycles) at high enough exposure times. Therefore, FIG. 8 in Lai et al., cannot teach or suggest depositing a thickness greater than 5A in each deposition cycle as required by claim 1.

The Examiner further refers to Lai et al. (Column 9, lines 55-65) to describe a CVD process where a film thickness of 300-1500 angstroms is achieved. The Applicant respectfully points out that a CVD process (a non-cyclical deposition process) is described to deposit bulk tungsten, not a plurality of deposition cycles with a thickness greater than 5 angstroms of a metal layer deposited in each deposition cycle as required by claim 1.

The Examiner further concludes that one of ordinary skill in the art would want to use the CVD thermal decomposition to deposit the tungsten carbonyl compound in Chung et al. as taught by Lai et al. because more than a monolayer can be deposited and the amount of gas pulses needed and complexity of the process would lessen, and that this is suggested by both references. The Applicant respectfully points out that this conclusion is flawed because, in Chung et al., a tungsten carbonyl compound is adsorbed on the substrate in each deposition cycle by exposing a substrate to a tungsten carbonyl precursor and then borane (a reducing gas) is exposed to the substrate to facilitate conversion to the tungsten carbonyl compound to

tungsten. However, claim 1 requires that a metal layer (a W metal layer in claim 38) be deposited with a thickness greater than 5 angstroms in each deposition cycle, not a tungsten carbonyl compound. As explained earlier, Lai et al. describes a CVD process to deposit bulk W metal.

Furthermore, the Examiner concludes that one of ordinary skill in the art would recognize that depositing the material by thermal decomposition would give a first layer of greater adherence to the substrate, which would be beneficial to both Chung et al. and Lai et al., and in addition, that one of ordinary skill in the art would be motivated to pulse a reducing gas even after the tungsten is deposited by CVD as taught by Chung et al. because pulsing the reducing gas allows for complete conversion to tungsten metal from tungsten carbonyl and ensures the desired film properties (paragraph [0033] of Chung et al.) The Examiner further states that both references state that cyclic deposition processes are beneficial to deposit layers of desired thickness in a controllable manner. Again, the Applicant respectfully points out that Chung et al. does not describe or teach the use of plurality of deposition cycles to deposit a metal layer with a thickness greater than 5 angstroms in each deposition cycle. Lai et al. does not cure that deficiency by describing a deposition of bulk W metal using a non-cyclical CVD process.

Ehlers et al. does not assist the Examiner with a rejection of the claims because it also fails to describe or suggest any of the features that are absent from Chung et al. and Lai et al.

In summary, the Applicant respectfully submits that claims 1-6, 8-20, 22, 24-26, 28-41, 43-55, 57, 59-61, and 63-82 are not rendered obvious by any of the references relied upon by the Examiner. In view of the foregoing, therefore, the Applicant respectfully requests reconsideration and allowance of the present application.

Should there be any minor issues to be resolved, the undersigned requests that the Examiner contact Audunn Ludviksson at (480) 539-2106.

If there are any fees required for this submission that are not otherwise accounted for, please charge any fees such associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-references Deposit Account.

Respectfully submitted

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